



DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. FAA-2023-2435; Notice No. 25-23-07-SC]

Special Conditions: Gulfstream Aerospace Corporation Model GVIII-G700 and GVIII-G800 Series Airplanes; Dynamic Test Requirements for Single- and Multiple-Occupant Side-Facing Seats With or Without Airbag Systems

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed special conditions.

SUMMARY: This action proposes special conditions for the Gulfstream Aerospace Corporation (Gulfstream) Model GVIII-G700 and GVIII-G800 series airplanes. These airplanes will have a novel or unusual design feature when compared to the state of technology envisioned in the airworthiness standards for transport category airplanes. This design feature is side-facing seats oriented in the aircraft with the occupant facing 90 degrees to the direction of aircraft travel. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These proposed special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

DATES: Send comments on or before [INSERT DATE 20 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

ADDRESSES: Send comments identified by Docket No. FAA-2023-2435 using any of the following methods:

Federal eRegulations Portal: Go to <https://www.regulations.gov/> and follow the online instructions for sending your comments electronically.

Mail: Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE, Room W12-140, West Building Ground Floor, Washington, DC, 20590-0001.

Hand Delivery or Courier: Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE, Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

Fax: Fax comments to Docket Operations at 202-493-2251.

Docket: Background documents or comments received may be read at <https://www.regulations.gov/> at any time. Follow the online instructions for accessing the docket or go to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE, Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: Myra Kuck, Cabin Safety, AIR-624, Technical Policy Branch, Policy and Standards Division, Aircraft Certification Service, Federal Aviation Administration, Aircraft Certification Policy and Standards, 3960 Paramount Blvd, Suite 100, Lakewood CA 90712; telephone and fax 405-666-1059; e-mail Myra.J.Kuck@faa.gov.

SUPPLEMENTARY INFORMATION:

Comments Invited

The FAA invites interested people to take part in this rulemaking by sending written comments, data, or views. The most helpful comments reference a specific portion of the proposed special conditions, explain the reason for any recommended change, and include supporting data.

On December 31, 2019, Gulfstream applied for an amendment to Type Certificate No. T00015AT to include the new Model GVIII-G700 and GVIII-G800 series airplanes.

While the comment period provided by the FAA for proposed special conditions has typically been thirty days, the FAA is providing twenty days in this instance, due to the relative similarity of these conditions with the terms of previously issued special conditions, and due to the pendency of the anticipated delivery date for the affected airplane models, per the criteria in 14 CFR 11.38.

The FAA will consider all comments received by the closing date for comments, and will consider comments filed late if it is possible to do so without incurring delay.

The FAA may change these special conditions based on the comments received.

Privacy

Except for Confidential Business Information (CBI) as described in the following paragraph, and other information as described in title 14, Code of Federal Regulations (14 CFR) 11.35, the FAA will post all comments received without change to <https://www.regulations.gov/>, including any personal information you provide. The FAA will also post a report summarizing each substantive verbal contact received about these special conditions.

Confidential Business Information

Confidential Business Information (CBI) is commercial or financial information that is both customarily and actually treated as private by its owner. Under the Freedom of Information Act (FOIA) (5 U.S.C. 552), CBI is exempt from public disclosure. If your comments responsive to these proposed special conditions contain commercial or financial information that is customarily treated as private, that you actually treat as private, and that is relevant or responsive to these special conditions, it is important that you clearly designate the submitted comments as CBI. Please mark each page of your submission containing CBI as "PROPIN." The FAA will treat such marked submissions as confidential under the FOIA, and the indicated comments will not be placed in the public docket of these special conditions. Send submissions containing CBI to the

individual listed in the For Further Information Contact section above. Comments the FAA receives, which are not specifically designated as CBI, will be placed in the public docket for these special conditions.

Background

As noted above, on December 31, 2019, Gulfstream applied for an amendment to Type Certificate No. T00015AT to include the new Model GVIII-G700 and GVIII-G800 series airplanes. These airplanes, which will be derivatives of the Model GVI currently approved under Type Certificate No. T00015AT, are twin-engine, transport-category airplanes, with seating for 19 passengers, and a maximum take-off weight of 107,600 pounds (GVIII-G700) and 105,600 pounds (GVIII-G800).

Type Certification Basis

Under the provisions of title 14, Code of Federal Regulations (14 CFR) 21.101, Gulfstream must show that the Model GVIII-G700 and GVIII-G800 series airplanes meet the applicable provisions of the regulations listed in Type Certificate No. T00015AT, or the applicable regulations in effect on the date of application for the change, except for earlier amendments as agreed upon by the FAA.

If the Administrator finds that the applicable airworthiness regulations (e.g., 14 CFR part 25) do not contain adequate or appropriate safety standards for the Gulfstream Model GVIII-G700 and GVIII-G800 series airplanes because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same novel or unusual design feature, these special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the Gulfstream Model GVIII-G700 and GVIII-G800 series airplanes must comply with the exhaust-emission requirements of 14 CFR part 34, and the noise-certification requirements of 14 CFR part 36.

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with 14 CFR 11.38, and they become part of the type certification basis under § 21.101.

Novel or Unusual Design Features

The Gulfstream Model GVIII-G700 and GVIII-G800 airplanes will incorporate the following novel or unusual design feature:

Side-facing seats, oriented in the aircraft with the occupant facing 90 degrees to the direction of aircraft travel, with or without incorporation of an airbag systems or inflatables.

Discussion

On June 16, 1988, Title 14, Code of Federal Regulations (14 CFR) part 25 was amended to revise the emergency landing conditions that must be considered in the design of transport category airplanes. This amendment (25-64) revised the static load conditions in § 25.561 and added a new § 25.562 that required dynamic testing for all seats approved for occupancy during takeoff and landing. The intent of Amendment 25-64 was to provide an improved level of safety for occupants on transport category airplanes; however, because most seating on transport category airplanes is forward-facing the pass/fail criteria developed in Amendment 25-64 focused primarily on these seats.

Prior to 2012, the FAA granted exemptions² for the multiple-place side-facing-seat installations because the existing test methods and acceptance criteria did not

² See, generally, Exemption Nos. 7120C, 7878A, 9900.

produce a level of safety equivalent to the level of safety provided for forward-and aft-facing seats. These exemptions were subject to many conditions that reflected the injury-evaluation criteria and mitigation strategies available at the time of the exemption issuance. The FAA also issued special conditions to address single-place side-facing seats because it determined, at the time, that those conditions provided the same level of safety as for forward- and aft-facing seats.

Due to the novelty of side-facing seats in transport category airplanes, acceptable safety measures for § 25.562 were unknown. The FAA conducted research to develop an acceptable method of compliance with §§ 25.562 and 25.785(b) for side-facing seat installations. That research has identified injury considerations and evaluation criteria in addition to those previously used to approve side-facing seats (see published report DOT/FAA/AR-09/41, July 2011³). One particular concern that was identified during the FAA’s research program but not addressed in special conditions prior to 2012 was the significant leg injuries that can occur to occupants of both single- and multiple-place side-facing seats. Because this type of injury does not occur on forward- and aft-facing seats, the FAA determined that to achieve the level of safety envisioned in Amendment 25-64, additional requirements would be needed as compared to previously issued special conditions. Nonetheless, the research has now allowed the development of a single set of special conditions that is applicable to all fully side-facing seats.

On November 5, 2012, the FAA released PS-ANM-25-03-R1, “Technical Criteria for Approving Side-Facing Seats,” to update existing FAA certification policy on §§ 25.562 and 25.785(a) and (b) at Amendment 25-64 for single- and multiple-place side-facing seats. This policy addresses both the technical criteria for approving side-facing seats and the implementation of those criteria. The FAA methodology detailed in PS-

³ Document available <https://www.tc.faa.gov/its/worldpac/techrpt/ar09-41.pdf>

ANM-25-03-R1 has been used to develop these proposed special conditions. Some of the conditions issued for previous exemptions are still relevant and are included in these proposed special conditions; however, others have been replaced by different criteria that reflect current research findings described above, as well as design features from the Gulfstream GVII model side-facing seat design.

The proposed special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

Applicability

As discussed above, these proposed special conditions are applicable to the Gulfstream Model GVIII-G700 and GVIII-G800 series airplanes. Should Gulfstream apply at a later date for a change to the type certificate to include another model that incorporates the same novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same novel or unusual design feature, these special conditions would apply to the other model as well.

Conclusion

This action affects only a certain novel or unusual design feature on Gulfstream Model GVIII-G700 and GVIII-G800 series of airplanes. It is not a rule of general applicability.

List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

Authority Citation

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(f), 106(g), 40113, 44701, 44702, and 44704.

The Proposed Special Conditions

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for Gulfstream Model GVIII-G700 and GVIII-G800 series airplanes.

In addition to the airworthiness standards in §§ 25.562 and 25.785, the FAA proposes the following special conditions as part of the type certification basis for the Gulfstream Model GVIII-G700 and GVIII-G800 series aircraft. Items 1 through 3 are applicable to all side-facing seat installations on these airplanes, whereas item 4 would impose requirements applicable to side-facing seats equipped with an airbag system in the shoulder belt, and item 5 would impose requirements applicable to side-facing seats equipped with leg-flail airbag systems.

1. Additional requirements applicable to tests or rational analysis conducted to show compliance with §§ 25.562 and 25.785 for side-facing seats:

a. The longitudinal test(s) conducted in accordance with § 25.562(b)(2) to show compliance with the seat-strength requirements of § 25.562(c)(7) and (8), and these special conditions must have an ES-2re anthropomorphic test dummy (ATD) (49 CFR part 572 subpart U) or equivalent, or a Hybrid-II ATD (49 CFR part 572, subpart B as specified in § 25.562) or equivalent, occupying each seat position and including all items contactable by the occupant (e.g., armrest, interior wall, or furnishing) if those items are necessary to restrain the occupant. If included, the floor representation and contactable items must be located such that their relative position, with respect to the center of the nearest seat place, is the same at the start of the test as before floor misalignment is applied. For example, if floor misalignment rotates the centerline of the seat place nearest the contactable item 8 degrees clockwise about the aircraft x-axis, then the item and floor representations must be rotated by 8 degrees clockwise also to maintain the same relative position to the seat place, as shown in Figure 1. Each ATD's relative position to the seat

after application of floor misalignment must be the same as before misalignment is applied. The ATD pelvis must remain supported by the seat pan, and the restraint system must remain on the pelvis and shoulder of the ATD until rebound begins. No injury-criteria evaluation is necessary for tests conducted only to assess seat-strength requirements.

b. The longitudinal test(s) conducted in accordance with § 25.562(b)(2), to show compliance with the injury assessments required by § 25.562(c) and these special conditions, may be conducted separately from the test(s) to show structural integrity. Structural-assessment tests must be conducted as specified in paragraph 1a, above, and the injury-assessment test must be conducted without yaw or floor misalignment. Injury assessments may be accomplished by testing with ES-2re ATD (49 CFR part 572 subpart U) or equivalent at all places. Alternatively, these assessments may be accomplished by multiple tests that use an ES-2re at the seat place being evaluated, and a Hybrid-II ATD (49 CFR part 572, subpart B, as specified in § 25.562) or equivalent used in all seat places forward of the one being assessed, to evaluate occupant interaction. Seat places aft of the one being assessed may be unoccupied. If a seat installation includes adjacent items that are contactable by the occupant, the injury potential of that contact must be assessed. To make this assessment, tests may be conducted that include the actual item, located, and attached in a representative fashion. Alternatively, the injury potential may be assessed by a combination of tests with items having the same geometry as the actual item, but having stiffness characteristics that would create the worst case for injury (injuries due to both contact with the item and lack of support from the item).

c. If a seat is installed aft of structure (e.g., an interior wall or furnishing) that does not have a homogeneous surface contactable by the occupant, additional analysis and/or test(s) may be required to demonstrate that the injury criteria are met for the area which

an occupant could contact. For example, different yaw angles could result in different injury considerations and may require additional analysis or separate test(s) to evaluate.

d. To accommodate a range of occupant heights (5th percentile female to 95th percentile male), the surface of items contactable by the occupant must be homogenous 7.3 inches (185 mm) above and 7.9 inches (200 mm) below the point (center of area) that is contacted by the 50th percentile male size ATD's head during the longitudinal test(s) conducted in accordance with paragraphs a, b, and c, above. Otherwise, additional head-injury criteria (HIC) assessment tests may be necessary. Any surface (inflatable or otherwise) that provides support for the occupant of any seat place must provide that support in a consistent manner regardless of occupant stature. For example, if an inflatable shoulder belt is used to mitigate injury risk, then it must be demonstrated by inspection to bear against the range of occupants in a similar manner before and after inflation. Likewise, the means of limiting lower-leg flail must be demonstrated by inspection to provide protection for the range of occupants in a similar manner.

e. For longitudinal test(s) conducted in accordance with § 25.562(b)(2) and these special conditions, the ATDs must be positioned, clothed, and have lateral instrumentation configured as follows:

(1) ATD positioning:

Lower the ATD vertically into the seat while simultaneously (see Figure 2 for illustration):

a) Aligning the midsagittal plane (a vertical plane through the midline of the body; dividing the body into right and left halves) with approximately the middle of the seat place.

b) Applying a horizontal x-axis direction (in the ATD coordinate system) force of about 20 pounds (lbs) (89 Newtons [N]) to the bottom of the feet of the ATD with the legs straight, to compress the seat back cushion.

c) Keeping the legs nearly horizontal by supporting them just behind the ankles

(d) Once all lifting devices have been removed from the ATD:

i) Rock it slightly to settle it in the seat.

ii) Gently lower the ankles of the ATD bending the legs at the knee joints. Do not allow the pelvis of the ATD to be moved when the lower legs are lowered. The seat back cushion must remain compressed. Separate the knees by about 4 inches (100 mm).

iii) Set the ES-2re's head at approximately the midpoint of the available range of z-axis rotation (to align the head and torso midsagittal planes).

iv) Position the ES-2re's arms at the joint's mechanical detent that puts them at approximately a 40-degree angle with respect to the torso. Position the Hybrid-II ATD hands on top of its upper legs.

v) Position the feet such that the centerlines of the lower legs are approximately parallel to a lateral vertical plane (in the aircraft coordinate system).

(2) ATD clothing: Clothe each ATD in form-fitting, mid-calf-length (minimum) pants and shoes (size 11E) weighing about 2.5 lb (1.1 Kg) total. The color of the clothing should be in contrast to the color of the restraint system. The ES-2re jacket is sufficient for torso clothing, although a form-fitting shirt may be used in addition if desired.

(3) ES-2re ATD lateral instrumentation: The rib-module linear slides are directional, i.e., deflection occurs in either a positive or negative ATD y-axis direction. The modules must be installed such that the moving end of the rib module is toward the front of the aircraft. The three abdominal-force sensors must be installed such that they are on the side of the ATD toward the front of the aircraft.

f. The combined horizontal/vertical test, required by § 25.562(b)(1) and these special conditions, must be conducted with a Hybrid II ATD (49 CFR part 572 subpart B as specified in § 25.562), or equivalent, occupying each seat position.

g. Restraint systems:

(1) If inflatable restraint systems are used, they must be active during all dynamic tests conducted to show compliance with § 25.562.

(2) The design and installation of seat-belt buckles must prevent unbuckling due to applied inertial forces or impact of the hands/arms of the occupant during an emergency landing.

2. Additional performance measures applicable to tests and rational analysis conducted to show compliance with §§ 25.562 and 25.785 for side-facing seats:

a. Body-to-body contact: Contact between the head, pelvis, torso, or shoulder area of one ATD with the adjacent-seated ATD's head, pelvis, torso, or shoulder area is not allowed. Contact during rebound is allowed.

b. Thoracic: The deflection of any of the ES-2re ATD upper, middle, and lower ribs must not exceed 1.73 inches (44 mm). Data must be processed as defined in Federal Motor Vehicle Safety Standards (FMVSS) 571.214.

c. Abdominal: The sum of the measured ES-2re ATD front, middle, and rear abdominal forces must not exceed 562 lbs (2,500 N). Data must be processed as defined in FMVSS 571.214.

d. Pelvic: The pubic symphysis force measured by the ES-2re ATD must not exceed 1,350 lbs (6,000 N). Data must be processed as defined in FMVSS 571.214.

e. Leg: Axial rotation of the upper-leg (femur) must be limited to 35 degrees in either direction from the nominal seated position.

f. Neck: As measured by the ES-2re ATD and filtered at CFC 600 as defined in SAE J211:

(1) The upper-neck tension force at the occipital condyle (O.C.) location must be less than 405 lb (1,800 N).

(2) The upper-neck compression force at the O.C. location must be less than 405 lb (1,800 N).

(3) The upper-neck bending torque about the ATD x-axis at the O.C. location must be less than 1,018 in-lb (115 Nm).

(4) The upper-neck resultant shear force at the O.C. location must be less than 186 lb (825 N).

g. Occupant (ES-2re ATD) retention: The upper-torso restraint straps (if present) must remain on the ATD's shoulder during the impact. The pelvic restraint must remain on the ES-2re ATD's pelvis during the impact. The pelvic restraint must remain on the ES-2re ATD's pelvis during rebound unless the following criteria are met. A 250 lb. lap belt tension limit based upon the findings in Civil Aerospace Medical Institute (CAMI) report DOT/FAA/AM-17/02. The data should be filtered at CFC 60 as defined in SAE J211. In order to complete the evaluation using this tension criteria, three things are needed

1. A clear indication of when the belt moves above the pelvis. Loose clothing can make it difficult to determine where the top of the pelvis is, and in turn make it hard to discern exactly when the belt moved above it. This can be improved by marking the top of the pelvis clearly and by positioning the cameras so that the position of the belt, relative to the top of the pelvis can be observed throughout the test (see Figure 3).

2. A measurement of the belt tension during the time when the belt moves above the pelvis. The webbing transducer should be placed to measure the total tension in the forward lap belt segment. If a split (combined body-centered and conventional) leading belt is used, the tension should be measured in the common section so that it reflects the contribution of each segment. Since this placement typically produces contact between the ATD and the transducer, it is important to use a webbing transducer that is not sensitive to contact.

3. Useful video and belt load data must be recorded until significant ATD rebound motion stops. Extra recording time is necessary because submarining usually occurs later

in the test than other injury criteria maximums. To completely capture ATD rebound, the necessary time could exceed 500 ms.

h. Occupant (ES-2re ATD) support:

(1) Pelvis excursion: The load-bearing portion of the bottom of the ATD pelvis must not translate beyond the edges of its seat's bottom seat-cushion supporting structure.

(2) Upper-torso support: The lateral flexion of the ATD torso must not exceed 40 degrees from the normal upright position during the impact.

3. For all airbag systems in the shoulder harness and for leg flail, the following apply:

a. Show that the airbag system will deploy and provide protection under crash conditions where it is necessary to prevent serious injury.

b. The means of protection must take into consideration a range of stature from a 2-year-old child to a 95th percentile male.

c. The airbag system must provide adequate protection for each occupant regardless of the number of occupants of the seat assembly, considering that unoccupied seats may have an active airbag system.

d. It must be shown that the airbag system is not susceptible to inadvertent deployment as a result of wear and tear, or inertial loads resulting from in-flight or ground maneuvers (including gusts and hard landings), and other operating and environmental conditions (vibrations, moisture, etc.) likely to occur in service.

e. Deployment of the airbag system must not introduce injury mechanisms to the seated occupant, or result in injuries that could impede rapid egress. This assessment should include an occupant whose seat belt is loosely fastened.

f. It must be shown that inadvertent deployment of the airbag system, during the most critical part of the flight, will either meet the requirement of § 25.1309(b) or not cause a hazard to the airplane or its occupants.

- g. It must be shown that the airbag system will not impede rapid egress of occupants 10 seconds after airbag deployment.
- h. The airbag system must be protected from lightning and high-intensity radiated fields (HIRF). The threats to the airplane specified in existing regulations regarding lightning, § 25.1316, and HIRF, § 25.1317, are adopted by reference for the purpose of measuring lightning and HIRF protection.
- i. The airbag system must function properly after loss of normal aircraft electrical power, and after a transverse separation of the fuselage at the most critical location. A separation at the location of the airbag system does not have to be considered.
- j. It must be shown that the airbag system will not release hazardous quantities of gas or particulate matter into the cabin.
- k. The airbag system installation must be protected from the effects of fire such that no hazard to occupants will result.
- l. A means must be available for a crewmember to verify the integrity of the airbag system prior to each flight, or it must be demonstrated to reliably operate between inspection intervals. The FAA considers that the loss of the airbag-system deployment function alone (i.e., independent of the conditional event that requires the airbag-system deployment) is a major-failure condition.
- m. The inflatable material may not have an average burn rate of greater than 2.5 inches/minute when tested using the horizontal flammability test defined in part 25, appendix F, part I, paragraph (b)(5).
- n. The airbag system, once deployed, must not adversely affect the emergency-lighting system (i.e., block floor proximity lights to the extent that the lights no longer meet their intended function).

o. The airbag system must perform its intended function after impact from other proximate assemblies (e.g., life raft) that may become detached under the loads specified in §§ 25.561 and 25.562.

4. For seats with an airbag system in the shoulder belts, the following apply:

a. The airbag system in the shoulder belt must provide a consistent approach to energy absorption throughout that range of occupants. The airbag system must be included in each of the certification tests as it would be installed in the airplane. In addition, the following situations must be considered:

(1) The seat occupant is holding an infant.

(2) The seat occupant is a pregnant woman.

b. The design must prevent the airbag system in the shoulder belt from being either incorrectly buckled or incorrectly installed, such that the airbag system in the shoulder belt would not properly deploy. Alternatively, it must be shown that such deployment is not hazardous to the occupant, and will provide the required injury protection.

5. For seats using an airbag system to meet the leg-flail conditions of 2.e. the following apply:

a. At some buttock popliteal length and effective seat bottom depth the lower legs will not be able to make a 90-degree angle with the upper leg; at this point the lower leg flail would not occur. The leg flail airbag system must provide a consistent approach to prevention of leg flail throughout that range of occupants whose lower legs can make a 90-degree angle with the upper legs when seated upright in the seat. Items that need to be considered include, but are not limited to the range of occupants' popliteal height, the range of occupants' buttock popliteal length, the design of the seat effective height above the floor, and the effective depth of the seat bottom cushion.

b. For all g-levels, if the design of the leg flail limited device does absorb some of the impact energy and returns only a portion to the legs (a qualitative assessment), then a rebound leg flail of greater than 35 degrees is acceptable.

c. Threshold test severity must be shown to be non-injurious (less than the post-mortem human subject (PMHS) low-g research testing) for g-levels up to the point where the leg flail airbag is designed to deploy.

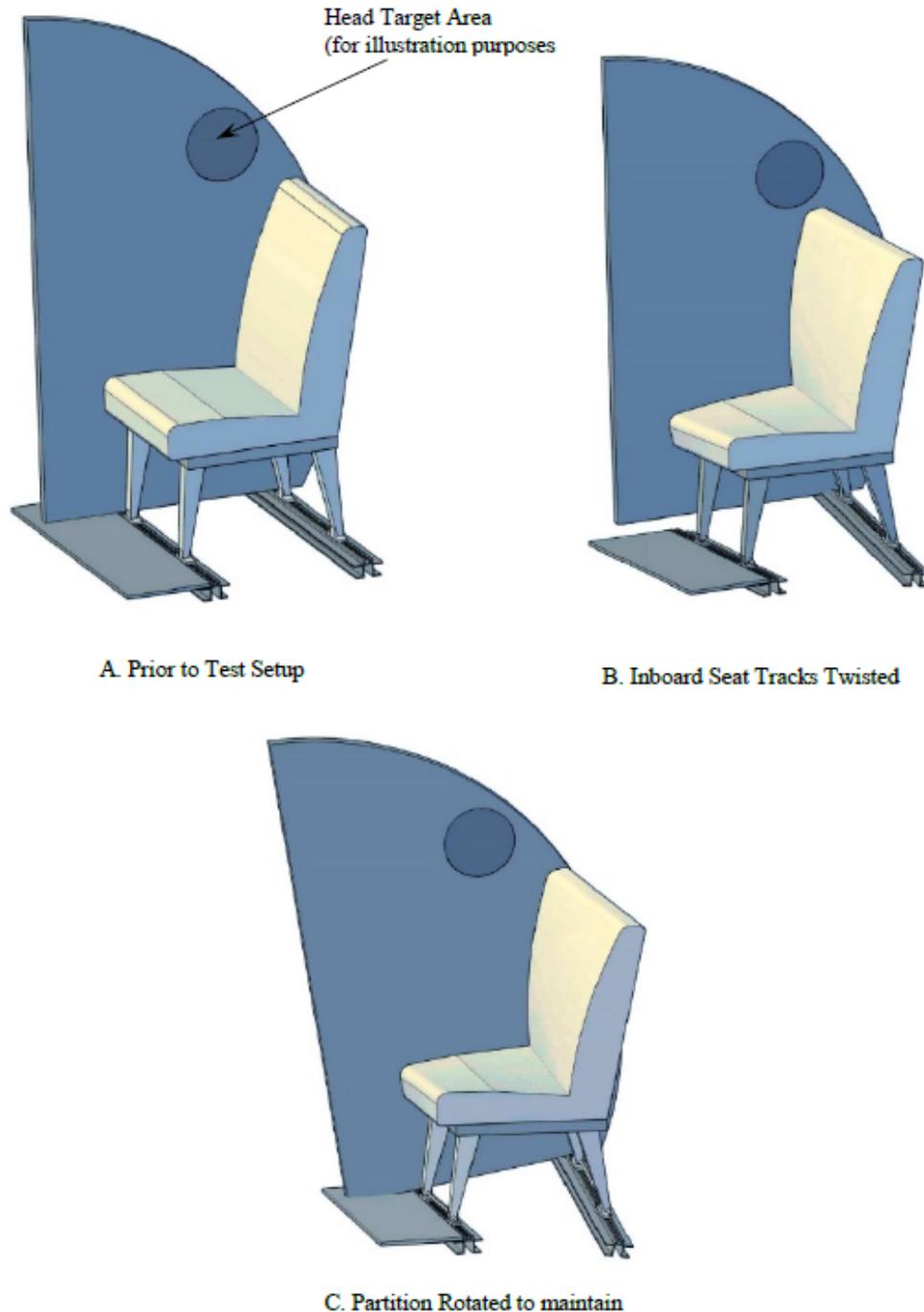


Figure 1

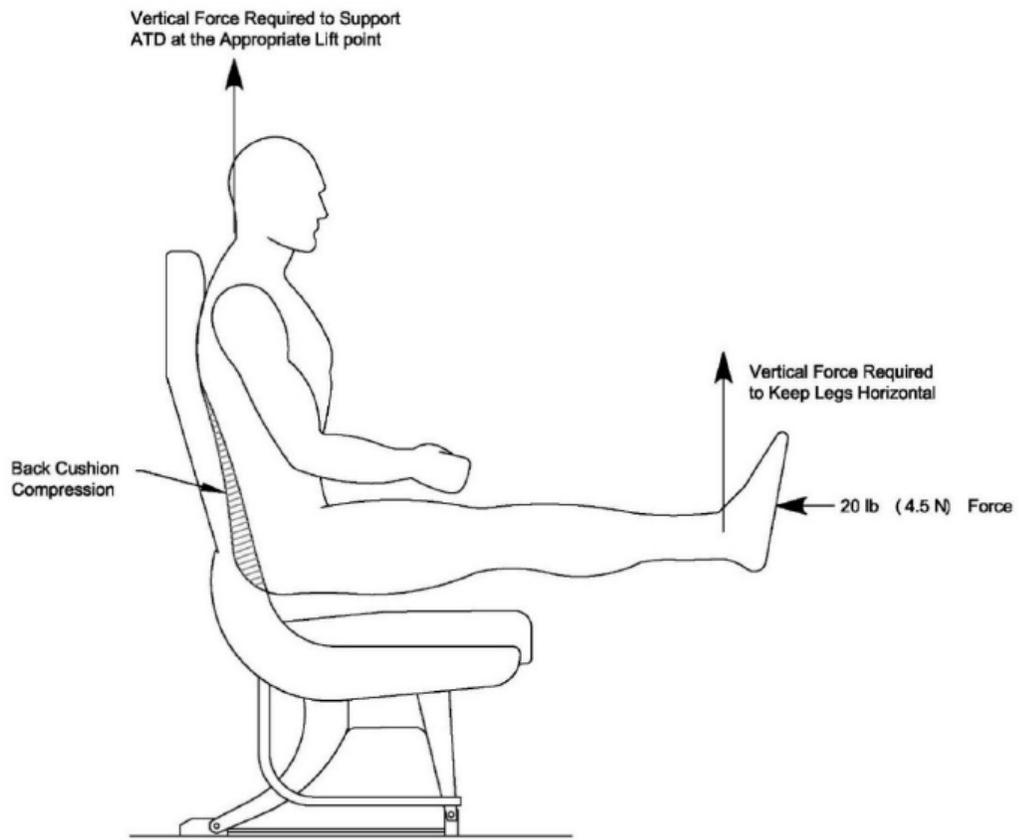


Figure 2



Figure 3

Issued in Kansas City, Missouri, on January 29, 2024.

Patrick R. Mullen,
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Policy and Innovation Division,
Aircraft Certification Service.

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